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# ASSESSMENT OF PHYSICO-CHEMICAL PROPERTIES IN SOIL FROM MANGO ORCHARDS OF RATNAGIRI DISTRICT

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## ABSTRACT

For present investigation, total 100 surface and 40 profile samples were collected from five mango orchards of Ratnagiri District. An effort had been made to study the influence of soil depth on distribution of various physico-chemical properties. From the data, it could be concluded that the physico-chemical properties of soils of mango orchards characteristically represented typical lateritic soils in the 'Very High Rainfall Laterite' (VRL) zone in the Konkan region. For improvement of physico-chemical properties of the soil, it was also concluded that, integrated nutrient approach and appropriate management practices should be followed.

**KEYWORDS:** Ratnagiri District, Mango (Alphonso), Physico-Chemical Properties

## INTRODUCTION

The world famous and the prime variety of mango, the Alphonso, enjoys virtual dominance both in domestic as well as international market due to its typical sugar-acid blend, attractive colour and shape, pleasant aroma, highly appreciable flavour, taste and distinctly having long keeping quality (Burondkar and Jadhav, 2009).

The Alphonso is chiefly produced in Ratnagiri district under study. The district is geographically situated in latitude of $16.58^0$ to $16.98^0$ N and longitude $73.18^0$ to $73.30\ ^0$E with humid; sub-tropical climate and high rainfall (average annual rainfall of 2515 to 3625 mm). The soil of the district is mainly lateritic. Here, mango is grown on hilly areas under rain-fed conditions.

Heavy rainfall and sloppy area possibly leads to alternation of physical and chemical properties which further affects the availability of various nutrients and finally soil fertility (Pereira *et al.,* 1986). The fertility status of soil is one of the most important factor governing the yield and quality of mango fruit. In case of mango crop, soil depth, texture, drainage, pH and native fertility are very important for sustaining its productivity. The crop is very sensitive to poor drainage and water logging conditions (Schaffer *et al.,* 1992). In addition, the crop is susceptible to higher salinity levels (Jindal *et al.,* 1975).

## MATERIAL AND METHODS

Five locations encompassing Ratnagiri district were selected from different tahsils namely Dapoli (Dapoli), Dapoli (Wakawali), Khed (Avashi), Ratnagiri (Shirgaon) and Lanja (Lanja). All the locations are the research stations or agricultural centers of Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli. At each location two mango orchards were selected. From each of the mentioned mango orchards, ten surface samples (0 to 15 cm) and one profile sample (0 to 15, 15 to 30, 30 to 45 and 45 to 60 cm) were collected. Thus, in all 100 surface soil samples and 40 profile samples were

collected in the month of April. The collection of samples, their processing, analysis and statistical analysis of data were done by following standard procedures.

## RESULTS AND DISCUSSIONS

**Table 1: Physico-Chemical Properties of Surface Soil Samples**

| Parameter | Range | | Average | Class |
|---|---|---|---|---|
| | From | To | | |
| Sand % | 35.16 | 66.90 | 52.23 | Sandy clay loam |
| Silt % | 10.12 | 23.76 | 17.24 | |
| Clay % | 16.83 | 44.40 | 30.71 | |
| MWHC % | 47.68 | 69.43 | 58.29 | medium to high |
| B. D. Mg $m^{-3}$ | 1.11 | 1.38 | 1.25 | _ |
| P.D. Mg $m^{-3}$ | 2.16 | 2.67 | 2.37 | _ |
| pH | 4.10 | 5.46 | 4.72 | moderately to strongly acidic |
| E.C. dS $m^{-1}$ | 0.027 | 0.098 | 0.052 | Normal |
| O.C. g $kg^{-1}$ | 11.02 | 18.18 | 15.00 | Very high |

**Table 2: Physico-Chemical Properties of Dapoli Profile Soil Samples**

| Mango Orchard Soil Depth (cm) | Mechanical Composition | | | Textural class | MWHC % | B.D. | P.D. | pH | E.C. dS $m^{-1}$ | O.C. g $kg^{-1}$ |
|---|---|---|---|---|---|---|---|---|---|---|
| | Sand | Silt | Clay | | | Mg $m^{-3}$ | | | | |
| | % | | | | | | | | | |
| **Profile (I)** | | | | | | | | | | |
| A | 50.06 | 19.55 | 30.39 | SCL | 48.76 | 1.36 | 2.32 | 4.87 | 0.056 | 16.69 |
| B | 46.70 | 17.55 | 35.75 | SCL | 56.70 | 1.20 | 2.55 | 4.99 | 0.068 | 12.22 |
| C | 44.10 | 15.66 | 40.24 | SC | 61.80 | 1.21 | 2.32 | 5.43 | 0.061 | 10.36 |
| D | 40.77 | 14.60 | 44.63 | SC | 64.43 | 1.25 | 2.43 | 5.70 | 0.078 | 08.97 |
| **Mean** | **45.41** | **16.84** | **37.75** | **SC** | **57.92** | **1.26** | **2.41** | **5.25** | **0.066** | **12.06** |
| **Profile (II)** | | | | | | | | | | |
| A | 54.30 | 19.20 | 26.50 | SCL | 58.67 | 1.31 | 2.49 | 4.67 | 0.023 | 14.35 |
| B | 50.50 | 15.00 | 34.50 | SCL | 62.23 | 1.22 | 2.43 | 4.98 | 0.034 | 12.22 |
| C | 43.40 | 12.00 | 44.60 | SC | 64.37 | 1.26 | 2.23 | 5.30 | 0.055 | 08.99 |
| D | 38.67 | 15.30 | 46.03 | CL | 69.88 | 1.23 | 2.29 | 5.66 | 0.048 | 08.12 |
| **Mean** | **46.72** | **15.38** | **37.91** | **SC** | **63.79** | **1.26** | **2.36** | **5.15** | **0.040** | **10.92** |
| **Profile mean** | **45.93** | **16.25** | **37.81** | **SC** | **60.27** | **1.26** | **2.39** | **5.21** | **0.055** | **11.49** |

A -0 to 15, B-15 to 30, C-30 to 45, D-45 to 60

**Table 3: Physico-Chemical Properties of Wakawali Profile Soil Samples**

| Mango Orchard Soil depth (cm) | Mechanical Composition | | | Textural class | MWHC % | B.D. | P.D. | pH | E.C. dS $m^{-1}$ | O.C. $gkg^{-1}$ |
|---|---|---|---|---|---|---|---|---|---|---|
| | Sand | Silt | Clay | | | Mg $m^{-3}$ | | | | |
| | (%) | | | | | | | | | |
| **Profile (I)** | | | | | | | | | | |
| A | 49.80 | 19.20 | 31.00 | SCL | 51.34 | 1.25 | 2.51 | 4.45 | 0.059 | 14.55 |
| B | 45.87 | 15.22 | 38.99 | SC | 59.76 | 1.18 | 2.24 | 4.69 | 0.068 | 13.03 |
| C | 47.60 | 11.15 | 41.43 | SCL | 60.69 | 1.14 | 2.18 | 5.60 | 0.039 | 11.52 |
| D | 41.30 | 12.55 | 46.15 | CL | 65.55 | 1.18 | 2.26 | 5.87 | 0.055 | 09.20 |
| **Mean** | **46.14** | **14.53** | **39.39** | **SC** | **59.34** | **1.19** | **2.30** | **5.15** | **0.055** | **12.08** |

| Table 3: Contd., | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Profile (II)** | | | | | | | | | | |
| A | 49.56 | 20.45 | 29.99 | SCL | 61.25 | 1.18 | 2.26 | 4.55 | 0.039 | 17.76 |
| B | 46.90 | 18.80 | 34.30 | SCL | 63.88 | 1.19 | 2.36 | 4.67 | 0.045 | 17.62 |
| C | 42.90 | 17.78 | 39.32 | SCL | 67.99 | 1.22 | 2.39 | 5.00 | 0.049 | 15.48 |
| D | 39.65 | 19.25 | 41.10 | SC | 69.77 | 1.23 | 2.25 | 5.45 | 0.061 | 16.52 |
| **Mean** | **44.75** | **19.07** | **36.18** | **SC** | **65.72** | **1.21** | **2.32** | **4.92** | **0.049** | **16.85** |
| **Profile mean** | **45.45** | **16.80** | **37.79** | **SC** | **62.53** | **1.20** | **2.31** | **5.04** | **0.052** | **14.47** |

A -0 to 15, B-15 to 30, C-30 to 45, D-45 to 60

**Table 4: Physico-Chemical Properties of Khed Profile Soil Samples**

| Mango orchard Soil depth (cm) | Mechanical Composition | | | Textural class | MWHC % | B.D. | P.D. | pH | E.C. dS $m^{-1}$ | O.C. g $kg^{-1}$ |
|---|---|---|---|---|---|---|---|---|---|---|
| | Sand | Silt | Clay | | | Mg $m^{-3}$ | | | | |
| | % | | | | | | | | | |
| **Profile (I)** | | | | | | | | | | |
| A | 49.70 | 16.58 | 33.72 | SCL | 48.67 | 1.23 | 2.29 | 5.33 | 0.064 | 16.87 |
| B | 47.60 | 15.47 | 36.93 | SCL | 56.90 | 1.20 | 2.28 | 5.33 | 0.057 | 15.56 |
| C | 48.21 | 13.68 | 38.11 | SCL | 60.34 | 1.33 | 2.49 | 5.67 | 0.027 | 10.94 |
| D | 38.90 | 16.40 | 44.70 | CL | 66.66 | 1.23 | 2.48 | 5.67 | 0.033 | 07.92 |
| **Mean** | **46.10** | **15.53** | **38.37** | **SCL** | **58.14** | **1.25** | **2.39** | **5.50** | **0.045** | **12.82** |
| **Profile (II)** | | | | | | | | | | |
| A | 52.44 | 18.22 | 29.34 | SCL | 58.79 | 1.27 | 2.56 | 4.77 | 0.048 | 13.05 |
| B | 48.98 | 15.87 | 35.15 | SCL | 60.67 | 1.21 | 2.43 | 4.94 | 0.049 | 14.58 |
| C | 43.43 | 11.16 | 45.41 | SC | 65.45 | 1.32 | 2.59 | 5.48 | 0.055 | 10.20 |
| D | 39.60 | 14.90 | 45.41 | SC | 64.23 | 1.18 | 2.63 | 5.70 | 0.059 | 06.54 |
| **Mean** | **46.11** | **15.04** | **38.83** | **SC** | **62.29** | **1.25** | **2.55** | **5.22** | **0.050** | **11.09** |
| **Profile mean** | **46.11** | **15.29** | **38.60** | **SC** | **60.22** | **1.25** | **2.47** | **5.36** | **0.048** | **11.96** |

A -0 to 15, B-15 to 30, C-30 to 45, D-45 to 60

**Table 5: Physico-Chemical Properties Of Ratnagiri Profile Soil Samples**

| Mango orchard Soil depth (cm) | Mechanical Composition | | | Textural class | MWHC % | B.D. | P.D. | pH | E.C. dS $m^{-1}$ | O.C. g $kg^{-1}$ |
|---|---|---|---|---|---|---|---|---|---|---|
| | Sand | Silt | Clay | | | Mg $m^{-3}$ | | | | |
| | % | | | | | | | | | |
| **Profile (I)** | | | | | | | | | | |
| A | 51.90 | 19.50 | 28.60 | SCL | 53.55 | 1.25 | 2.48 | 4.41 | 0.038 | 14.94 |
| B | 52.65 | 14.71 | 32.64 | SCL | 54.45 | 1.18 | 2.56 | 4.49 | 0.048 | 16.66 |
| C | 49.88 | 15.20 | 34.92 | SCL | 58.77 | 1.10 | 2.24 | 4.99 | 0.059 | 08.80 |
| D | 49.88 | 11.54 | 38.58 | SC | 63.89 | 1.23 | 2.18 | 5.19 | 0.053 | 08.80 |
| **Mean** | **51.08** | **15.24** | **33.69** | **SCL** | **57.67** | **1.19** | **2.37** | **4.77** | **0.050** | **12.30** |
| **Profile (II)** | | | | | | | | | | |
| A | 56.60 | 20.78 | 22.62 | SCL | 58.80 | 1.26 | 2.20 | 4.23 | 0.066 | 16.73 |
| B | 51.66 | 23.60 | 24.74 | SCL | 64.78 | 1.20 | 2.47 | 4.90 | 0.038 | 12.10 |
| C | 48.70 | 22.23 | 29.07 | SCL | 60.60 | 1.30 | 2.59 | 5.12 | 0.051 | 09.83 |
| D | 44.66 | 28.24 | 27.10 | SCL | 65.70 | 1.32 | 2.61 | 5.12 | 0.036 | 05.96 |
| **Mean** | **50.41** | **23.71** | **25.88** | **SCL** | **62.47** | **1.27** | **2.47** | **4.84** | **0.048** | **11.16** |
| **Profile mean** | **50.75** | **19.48** | **29.79** | **SCL** | **60.07** | **1.23** | **2.42** | **4.81** | **0.049** | **11.73** |

A -0 to 15, B-15 to 30, C-30 to 45, D-45 to 60

**Table 6: Physico-Chemical Properties of Lanja Profile Soil Samples**

| Mango orchard Soil depth (cm) | Mechanical Composition | | | Textural class | MWHC % | B.D. | P.D. | pH | E.C. dS $m^{-1}$ | O.C. g $kg^{-1}$ |
|---|---|---|---|---|---|---|---|---|---|---|
| | Sand | Silt | Clay | | | Mg $m^{-3}$ | | | | |
| | % | | | | | | | | | |
| **Profile (I)** | | | | | | | | | | |
| A | 53.36 | 11.52 | 35.12 | SCL | 59.05 | 1.25 | 2.28 | 4.67 | 0.027 | 14.52 |
| B | 51.88 | 12.56 | 35.56 | SCL | 60.88 | 1.18 | 2.54 | 5.19 | 0.047 | 13.43 |
| C | 54.67 | 11.77 | 33.56 | SCL | 62.44 | 1.10 | 2.39 | 5.66 | 0.034 | 13.97 |
| D | 41.65 | 10.50 | 47.85 | CL | 68.78 | 1.23 | 2.36 | 5.66 | 0.044 | 10.95 |
| **Mean** | **50.39** | **11.59** | **38.02** | **SC** | **62.79** | **1.19** | **2.39** | **5.30** | **0.038** | **13.22** |
| **Profile (II)** | | | | | | | | | | |
| A | 54.46 | 13.32 | 32.22 | SCL | 58.70 | 1.19 | 2.45 | 4.54 | 0.058 | 16.02 |
| B | 47.89 | 11.56 | 40.55 | SC | 65.46 | 1.32 | 2.42 | 4.97 | 0.054 | 15.09 |
| C | 43.67 | 11.56 | 44.77 | SC | 65.46 | 1.22 | 2.21 | 5.13 | 0.056 | 14.46 |
| D | 40.80 | 13.44 | 45.76 | CL | 68.90 | 1.24 | 2.30 | 5.44 | 0.072 | 10.57 |
| **Mean** | **46.71** | **12.47** | **40.83** | **SC** | **64.63** | **1.24** | **2.35** | **5.02** | **0.060** | **14.04** |
| **Profile mean** | **48.55** | **12.03** | **39.43** | **SC** | **63.71** | **1.22** | **2.37** | **5.16** | **0.049** | **13.63** |

A -0 to 15, B-15 to 30, C-30 to 45, D-45 to 60

The consolidated data in the above tables (table 1 to 6) is elaborated below.

The data on mechanical composition revealed dominancy of 'Sandy clay loam' textural class for surface samples and 'sandy clay' for profile samples. For all the profiles, the sand content showed a decreasing trend with soil depth with exception of Dapoli (III), Khed (I), Ratnagiri (I) and Lanja (I) locations. However, the higher sand content in the surface soil than in the profile may be due to less weathering of the parent material in upper surface of the soil (Sehgal, 1996). In all the mango orchards, silt content did not show any definite trend in its distribution with soil depth with an exception of Dapoli (I), where a decreasing trend of silt content was observed. Increasing trend of clay content with soil depth was seen for all tahsils, while Lanja (I), Ratnagiri (II) and Khed (II) were found as exceptions for these findings. However, increase in the clay content with the soil depth might be due to translocation of clay fraction from the surface soil down to the profile (Subbaiah and Manickam, 1992). These results were also in conformity with Suryavanshi (2010).

The bulk density at all soil profiles did not show any definite trend with exception of Dapoli (IV) mango orchard where an increasing trend of bulk density was observed. In case particle density, soil profiles showed no definite trend with soil depth with exception of Ratnagiri (II) location. At Ratnagiri (II), an increasing trend of particle density with soil depth was seen.

All the surface and profile soil samples were categorized into 'medium to high' class (on the basis of ratings given by Sankaram, 1996) of maximum water holding capacity. At profile samples an increasing trend with soil depth was noticed except Khed (II), Lanja (II) and Ratnagiri (II) mango orchards. Similar findings were observed by Sankpal (2008) for lateritic soils. The increasing trend of maximum water holding capacity may be due to increase in clay content with soil depth (Revandkar, 1990).

The samples (surface and profile) were 'moderately to strongly acidic in reaction indicated acidic nature of soils of mango orchards. Similar results were indicated by Gaidhani (2008). The low pH values of all mango orchards might be due to higher leaf litter addition to soil which helps in acceleration of mineralization process (Sanborn, 2001 and Wilson, 2007). The data related to soil pH further showed an increasing trend for pH values with soil depth at all tahsils while Khed

(I), Lanja (I) and Ratnagiri (II) locations were found as exceptions for these findings. The increasing trend of pH for most of the tahsils attributed to increase in soil alkalinity with depth due to deposition of basic salts by irrigation and eluviations (Patil *et al.*,2008).

Electrical conductivity for surface and profile samples were found under 'normal' class (based on the ratings given by Seth, 1967) which indicated that all the mango orchards had low salt concentration. Similar results were observed by Shinde (2006) for lateritic soils of Konkan. Electrical conductivity showed no definite trend with soil depth at all mango orchards with exceptions of Dapoli (IV) and Khed (II) locations.

In case of organic carbon, all the samples (surface and profile) were categorised as "Very high" (as per the ratings given by Banger and Zende, 1978) indicated presence of sufficient amount of organic carbon content in the soils of mango orchards. The results are in conformity with Suryavanshi (2010). However, the high amount of organic carbon content in the soils may be attributed to luxurious growth of grasses and vegetation due to heavy rainfall and thus addition of organic matter through litter, residues and cover crops and thereby subsequent increased humification (Preethi *et al.*,1998). The data on organic carbon content showed that all mango orchards had a decreasing trend of organic carbon with depth of soil with exceptions of Dapoli (IV), Khed (II) Ratnagiri (I) and Lanja (I) locations. The high carbon content in the surface soil than subsurface layers may be attributed to profused root growth of grasses in surface layers than subsurface (Mahajan, 2001).

## CONCLUSIONS

From the data, it could be concluded that the physico-chemical properties of soils of mango orchards characteristically represented typical lateritic soils in the 'Very High Rainfall Laterite (VRL) zone in the Konkan region. The soils had higher content of sand than clay content. Also the soil samples were found to be acidic in reaction.

Considering the findings, in future balanced use of organic and inorganic fertilizers along with appropriate management practices should be followed for improvement of physico-chemical properties to sustain fertility status.

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